

# SHANTANU NAIDU

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Postdoctoral scholar at NASA Jet Propulsion Laboratory. Planetary radar astronomer and electrical engineer. Over 10 years of programming experience with various computer languages. Adept at scientific writing and designing graphics/animations to convey scientific data and results to public.

## EDUCATION

<b>Ph.D. in Geophysics and Space Physics, University of California, Los Angeles</b>	GPA: 3.99	2015
Dissertation: Dynamics of Binary Near-Earth Asteroids: A study based on radar observations		
<b>M.S. in Geophysics and Space Physics, University of California, Los Angeles</b>	GPA: 3.99	2012
<b>M.S. in Telecommunications, University of Maryland, College Park</b>	GPA: 4.00	2009
<b>B.E. in Electronics Engineering, Mumbai University</b>	1st Class	2007

## AWARDS

Harold and Mayla Sullwold Scholarship for outstanding original research	2013
ENTS Scholarship at University of Maryland for academic performance	2008
JRD Tata Trust Scholarship for academic performance	2004

## SKILLS

<b>Observing:</b> Radar (Arecibo, Goldstone, Green Bank), Optical (Keck 10m, Lick 1m, McMath-Pierce 1.6m solar)	
<b>Languages:</b> C, C++, Python, Perl, BASH, IDL, MATLAB, HTML, CSS, VRML & X3D (for 3D graphics)	
<b>Tools:</b> NAIF SPICE, Latex, IRAF, Blender	

## WORK EXPERIENCE

<b>Caltech Postdoctoral Researcher - Jet Propulsion Lab, California Institute of Technology</b>	2015-Now
<ul style="list-style-type: none"><li>Working on physical modeling of near-Earth asteroid, Didymos, to enable a joint NASA and ESA spacecraft mission (Asteroid Impact &amp; Deflection Assessment Study mission)</li><li>Leading radar observations for tracking and physical characterization of several near-Earth asteroids</li><li>Developed software to alert observers of radar opportunities for newly discovered asteroids</li><li>Studied the capabilities of various planetary radar facilities in terms of number of asteroids they can detect per year</li></ul>	
<b>Graduate Student Researcher - Department of Earth, Planetary, and Space sciences, UCLA</b>	2010-2015
<ul style="list-style-type: none"><li>Developed a very fast numerical integration technique for spin-orbit simulations of binary systems and applied it to study dynamics of binary asteroids</li><li>Developed software to design space missions to near-Earth asteroids</li><li>Observed Jupiter Trojans using the Keck telescope for discovering and characterizing binaries</li><li>Developed software to extract eclipses and occultations from lightcurves of binary asteroids</li><li>Designed and created 3-D graphics &amp; animations for visualizing asteroid shape models and physical properties (e.g. <a href="https://vimeo.com/85406899">https://vimeo.com/85406899</a> )</li></ul>	
<b>Faculty Research Assistant - Department of Astronomy, University of Maryland</b>	2009-2010
<ul style="list-style-type: none"><li>Mapped the surfaces of asteroids Vesta and Ceres in infrared using the Hubble Space Telescope to prepare for the DAWN space mission</li><li>Observed and mapped the Sodium exospheres of Mercury and the Moon to understand the source processes</li></ul>	

## OTHER PROJECTS

<b>University of Maryland</b>	2007-2010
<ul style="list-style-type: none"><li>Modeled performance of 802.11 (Wi-Fi) in ad-hoc networks (OPNET modeler)</li><li>Studied network intrusion detection and prevention products</li></ul>	

- Studied radio-frequency identification (RFID) system security
- Simulated cellular network (GSM) deployment using “MaXPlan” software

#### Mumbai University

2003-2007

- Implemented an “Emergency Information Dissemination System” (Hardware & Software)
- Built microcontroller based autonomous robots

#### TEACHING EXPERIENCE

Assisted in teaching “Solar system and the planets” to over 100 undergraduate students

2012

#### WORKSHOPS

##### Jet Propulsion Laboratory - Planetary Science Summer School

2012

- Designed in detail a space mission to Jupiter’s moon, Io, to study its surface and atmosphere
- Led the design of the telecommunications subsystem on the spacecraft and the radio science group

##### Greenbank Telescope - Single-Dish Radio Astronomy Workshop

2011

#### DISCOVERIES (ASTEROID SATELLITES)

Naidu, S. P.; Benner, L. A. M.; Brozovic, M.; Giorgini, J. D.; Jao, J. S.; Lee, C. G; Snedeker, L. G.; Lawrence, K. J.; Busch, M. W.; Taylor, P. A.; Richardson, J. E.; Rivera-Valentin, E. G. “(410777) 2009 FD.” Central Bureau for Astronomical Telegrams, 4191, 2015

Naidu, S. P.; Benner, L. A. M.; Brozovic, M.; Giorgini, J. D.; Jao, J. S.; Lee, C. G; Snedeker, L. G.; Lawrence, K. J.; Busch, M. W. “(348400) 2005 JF\_21.” Central Bureau for Astronomical Telegrams, 4139, 2015

Naidu, S. P.; Benner, L. A. M.; Brozovic, M.; Giorgini, J. D.; Jao, J. S.; Lee, C. G; Snedeker, L. G.; Lawrence, K. J.; Busch, M. W. “2014 YB\_35.” Central Bureau for Astronomical Telegrams, 4121, 2015

Brozovic, M.; Benner, L. A. M.; Taylor, P. A.; Howell, E. S.; Nolan, M. C.; Margot, J. L.; Giorgini, J. D.; Busch, M. W.; Naidu, S. P.; Nugent, C.; Magri, C.; Shepard, M. K. “2004 FG11” Central Bureau for Astronomical Telegrams, 3175, 2012

Taylor, P. A.; Nolan, M. C.; Howell, E. S.; Benner, L. A. M.; Brozovic, M.; Giorgini, J. D.; Margot, J. L.; Busch, M. W.; Naidu, S. P.; Nugent, C.; Magri, C.; Shepard, M. K. “2004 FG11” Central Bureau for Astronomical Telegrams, 3091, 2012

#### PUBLICATIONS

Naidu, S. P.; Benner, L. A. M.; Margot, J. L.; Busch, M. W. “Capabilities of ground-based radar facilities for near-Earth asteroid observations” **in preparation**

Yang Y.; Michel, P.; Schwartz, S. R.; Naidu, S. P.; Benner, L. A. M. “Ejecta Cloud from a Kinetic Impact on the Secondary of a Binary Asteroid: I. Mechanical Environment and Dynamic Model” **submitted to Icarus**

Michel, P.; Cheng, A.; Kuppers, M.; Pravec, P.; Blum, J.; Delbo, M.; Green, S. F.; Rosenblatt, P.; Tsiganis, K.; Vincent, J. B.; Biele, J.; Ciarletti, V.; Herique, A.; Ulamec, S.; Carnelli, I.; Galvez, A.; Benner, L. A. M.; Naidu, S. P.; and 9 co-authors “Science case for the Asteroid Impact Mission (AIM): a component of the Asteroid Impact & Deflection Assessment (AIDA) Mission” **submitted to Advances in Space Research**.

Pravec, P.; Scheirich, P.; Kusnirak, P. Hornoch, K.; Galad, A.; Naidu, S. P.; and 42 co-authors “Binary asteroid population. 3. Secondary rotations and elongations” **accepted to Icarus**.

Naidu, S. P.; Margot, J. L.; Taylor, P. A.; Nolan, M. C.; Busch, M. W.; Benner, L. A. M.; Brozovic, M.; Giorgini, J. D.; J. Jao; Magri, C. “Radar characterization of binary near-Earth Asteroid (185851) 2000 DP107.” **Astronomical Journal 150.2, 54, 2015**

Naidu, S. P.; Margot, J. L. “Near-Earth Asteroid Satellite Spins Under Spin-Orbit Coupling.” **The Astronomical Journal 149.2, 80, 2015**

Naidu, S. P.; Margot, J. L.; Busch, M. W.; Taylor, P. A.; Nolan, M. C.; Brozovic, M.; Benner, L. A. M.; Giorgini, J. D.;

Magri, C. "Radar imaging and physical characterization of near-Earth Asteroid (162421) 2000 ET70." *Icarus*, 226, Issue 1, pp. 323-335, 2013.

Mouawad, N.; Burger, M. H.; Killen, R. M.; Potter, A. E.; McClintock, W. E.; Vervack, R. J.; Bradley, E. T.; Benna, M.; Naidu, S. P. "Constraints on Mercury's Na exosphere: Combined MESSENGER and ground-based data." *Icarus*, 211, Issue 1, pp. 21-36, 2011.

Killen, R. M.; Potter, A. E.; Hurley, D. M.; Plymate, C.; Naidu, S. P. "Observations of the lunar impact plume from the LCROSS event." *Geophysical Research Letters*, 37, Issue 23, L23201, 2010.

## CONFERENCE TALKS (FIRST AUTHOR ONLY)

Naidu, S. P.; Benner, L. A. M.; Brozovic, M.; Giorgini, J. D.; Jao, J. S.; Busch, M. W.; Taylor, P. A.; Richardson, J. E.; Rivera-Valentin, E. G.; Ford, L. A.; Ghigo, F. D.; Kobelski, A. "Radar observations of near-Earth asteroid (436724) 2011 UW158 using the Arecibo, Goldstone, and Green Bank Telescopes." American Astronomical Society, DPS meeting #47, #204.08, Nov 8-13, 2015

Naidu, S. P.; Benner, L. A. M.; Margot, J. L. "Capabilities and Comparisons of Ground-Based Radar Facilities for Near-Earth Asteroid Observations." Future of Planetary Radio Astronomy with Single-Dish Telescopes workshop, June 9 - June 10, 2015.

Naidu, S. P.; Margot, J. L. "Binary Near-Earth Asteroids: Satellite Spin States under Spin-Orbit." Asteroids, Comets, Meteors meeting, June 30 - July 04, 2014.

Naidu, S. P.; Margot, J. L. "Binary Near-Earth Asteroids: Satellite Spin States under Spin-Orbit." American Astronomical Society, DDA meeting #45, #103.05, 2014. April 28 - May 01, 2014.

Naidu, S. P.; Margot, J. L. "Coupled Spin and Orbital Dynamics of Binary Near-Earth Asteroids 2000 DP107 and 1991 VH." American Astronomical Society, DPS meeting #45, #112.09, 2013.

Naidu, S. P.; Margot, J. L.; Busch, M. W.; Taylor, P. A.; Nolan, M. C.; Giorgini, J. D.; Benner, L. A. M.; Magri, C. "Radar Characterization of Binary Near-Earth Asteroid (185851) 2000 DP107." 3rd Workshop on Binaries in the Solar System, Hawaii, the Big Island (USA). June 30 - July 2, 2013.

Naidu, S. P.; Margot, J. L.; Taylor, P. A.; Nolan, M. C.; Brozovic, M.; Benner, L. A. M.; Giorgini, J. D.; Howell, E. S.; Busch, M. W.; Magri, C. "Radar Observations and Shape Modeling of Near-Earth Asteroid (162421) 2000 ET70." American Astronomical Society, DPS meeting #44, #302.06, 2012.

Naidu, S. P.; Margot, J. L.; Nolan, M. C.; Busch, M. W.; Fang, J.; Taylor, P. A.; Howell, E. S.; Giorgini, J. D.; Benner, L. A. M.; Brozovic, M.; Magri, C. "Binary Near-Earth Asteroid 2000 DP107, a Prime Spacecraft Target." 39th COSPAR Scientific Assembly. 14-22 July 2012, in Mysore, India. Abstract F4.2-10-12, p.1319, 2012.

Naidu, S. P.; Margot, J. L.; Busch, M. W.; Taylor, P. A.; Nolan, M. C.; Howell, E. S.; Giorgini, J. D.; Benner, L. A. M.; Brozovic, M.; Magri, C. "Dynamics of Binary Near-Earth Asteroid System (35107) 1991 VH." American Astronomical Society, DDA meeting #43, #7.07, 2012.

Naidu, S. P.; Margot, J. L.; Busch, M. W.; Taylor, P. A.; Nolan, M. C.; Howell, E. S.; Giorgini, J. D.; Benner, L. A. M.; Brozovic, M.; Magri, C. "Binary Near-Earth Asteroid 2000 DP107: Component Shapes, Mutual Orbit, and Evolution." EPSC-DPS Joint Meeting 2011, Vol. 6, pp.310, 2011.

Naidu, S. P.; Killen, R. M.; Sarantos, M.; Potter, A. E.; Sharma, A. S. "Lunar Sodium Data and Constraints on Source Processes." American Astronomical Society, DPS meeting, 40, pp. 406, 2008